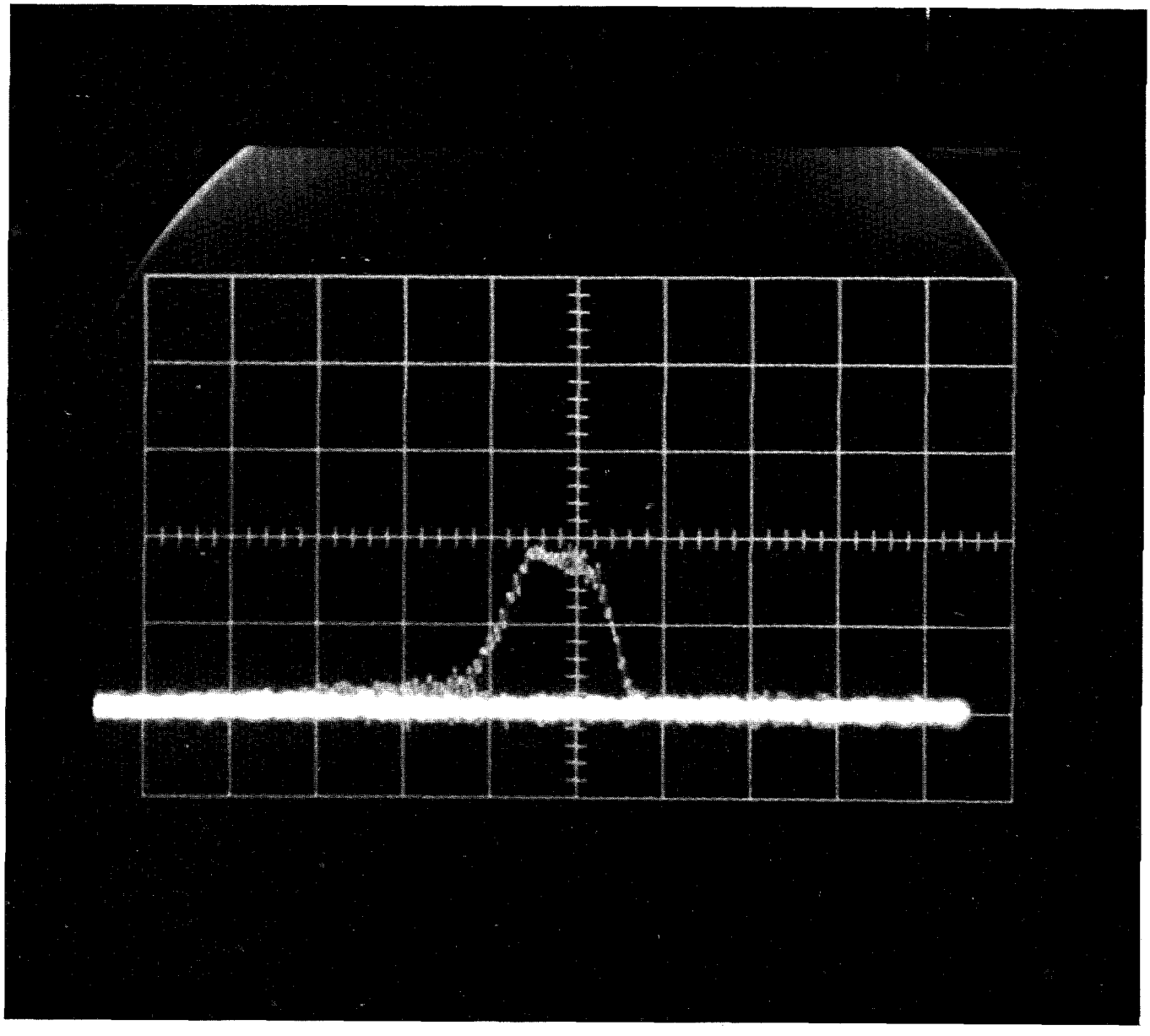
national accelerator laboratory FERMILAB-NAL-047

MONTHLY REPORT OF ACTIVITIES

September 30, 1970



139-MeV PROTON BEAM

Operated by Universities Research Association Inc. Under Contract with the United States Atomic Energy Commission

THE COVER: The cover shows a beam pulse at a detector beyond the linac. The vertical scale is 2 milliamperes per centimeter and the horizontal scale is 5 microseconds per centimeter.

NAL-47
0090.01

MONTHLY REPORT OF ACTIVITIES

F. T. Cole

September 30, 1970

Abstract: This report summarizes the activities of the National Accelerator Laboratory in September, 1970.

Oktoberfest

In what we are calling the "Oktoberfest," we are setting ourselves the goal of accelerating protons to 139 MeV in the Linac and transporting them through half the Booster and into the Main Accelerator. All components necessary for this exercise are scheduled to be installed ready for operation by October 1. This part of the schedule has been met, as discussed under the separate accelerators below.

Linac

1. 139-MeV Beam. The Linac Section is playing host to the 1970 Proton Linear Accelerator Conference from September 29 to October 2. Figure 1 shows the opening session. In order to have time for the conference, the

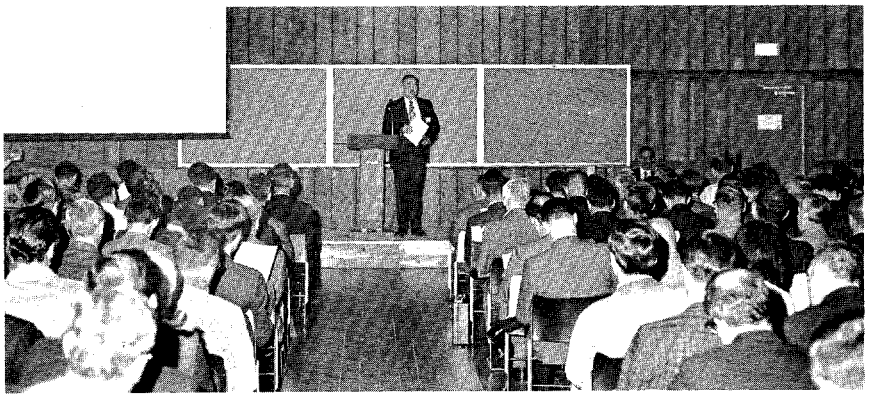


Fig. 1. Donald Young speaking at the opening session of the 1970 Proton Linear Accelerator Conference. Philip Livdahl of the Linac Section is seared at the session chairman's table to the right, facing the audience.

Linac Section achieved acceleration of beam to 139 MeV, on September 25, six days ahead of schedule. The cover photograph is a beam trace taken at that time. During the Conference, the linac technicians demonstrated their ability to turn on and run the linac.

Thus, six of the nine linac tanks are now in operation. No measurements of emittance or maximum current have yet been made, because the linac beam is in use as an injector for the other parts of the Oktoberfest. In fact, the linac is being purposely operated at reduced intensity, pulse length, and repetition rate for these studies. Its operation has been satisfactorily stable.

2. Construction. Tank 8 has been moved to the permanent building. Tank 9, the last cavity, is still in the Village, awaiting only completion of the Oktoberfest for its movement to its final location. All drift-tube fabrication has been completed and installation and alignment are in progress in Tank 7. Figure 2 is a photograph of the inside of Tank 6.

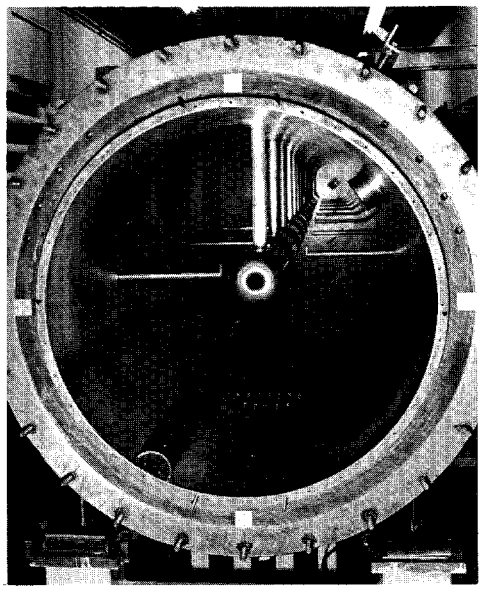


Fig. 2. Interior view of Tank 6 showing the drift tubes post-couplers used for rf stabilization of the tank.

Booster

For the Oktoberfest, the 200-MeV beam-transport injection system, and one half the ring have been installed, aligned, and are under vacuum and powered. In fact, the beam-transport line has not only been powered, but is operating under computer control. The half ring has been powered, not just to fields corresponding to 139 MeV, but also to peak fields (corresponding to 8 GeV) with success.

Main Accelerator

All of Superperiod A, the first one-sixth of the ring, has been installed, aligned, and is under vacuum and powered, ready for the Oktoberfest. Part of the superperiod has been successfully pulsed to field levels corresponding to 200 BeV. Figure 3 is a recent photograph of the main accelerator.

Fig. 3. Interior of the main ring in Superperiod A.

In all, 262 magnets have been completed and 180 are in the tunnel. The piping installation is complete in Superperiod A, 85% complete in Superperiod B, and has started in Superperiod C, in which the tunnel is now entirely occupied by the Laboratory.

Beam Transfer

The booster extraction system and the 8-GeV beam line to the main accelerator have also been installed and are under vacuum and powered. All these elements are operating under computer control. Figure 4 shows the injection beam line in the Transfer Hall.

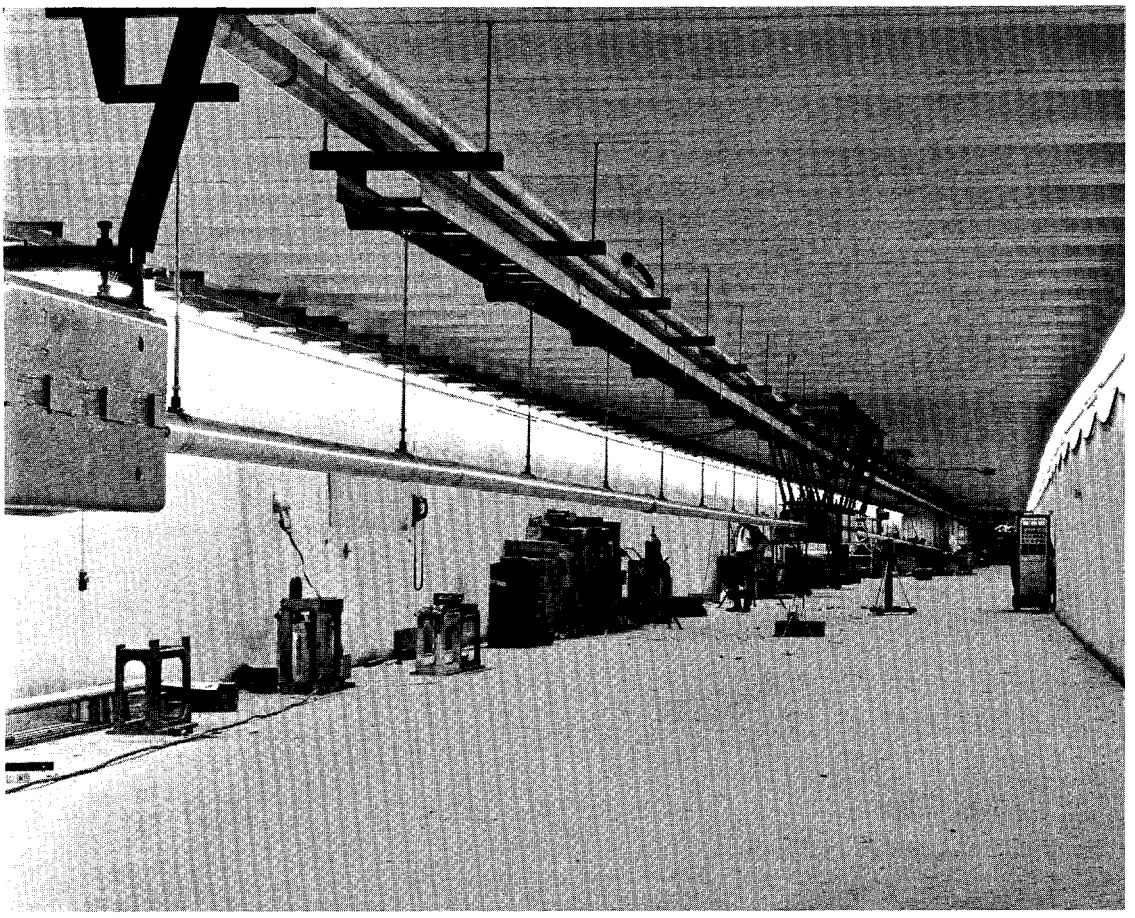


Fig. 4. The Transfer Hall. The view is downstream. The pipe is the injection beam line. The long straight section is beyond the hanging magnets.

Radiation Physics

In addition to participating in the design work on experimental areas discussed below, the Radiation Physics Section is providing radiation survey and monitoring services in the 139-MeV operation discussed above. Remanent-radiation surveys after some operation have shown negligible activation of the linac itself, but some activity in the 200-MeV transport line, generated during tuneup of the temporary system. There is also some neutron activity outside the temporary door through which the linac tanks are be being brought in. The present operation is all being done at night, with access controlled so that there are no people in that area. After the last linac tank is installed, this door will be covered with earth shielding.

Radio Frequency

1. Booster. The first two rf stations have been installed in the Booster and operated. RF stations 3 and 4 are being assembled in the Village prior to installation. It is hoped that the 139-MeV operation might provide an opportunity to study cavity excitation by the beam in the first station, which is just beyond the extraction point.

2. Main Ring. One prototype cavity has been operated at 270 kilovolts peak rf voltage across the gap, higher than the design specification. It is being returned to the manufacturer for replating to improve its quality factor. The other prototype cavity has been returned from the manufacturer. It has now operated at 300 kilovolts for short pulses. Additional cooling is being installed to give longer high-power pulses. Some sparking is also being observed and investigated in this cavity. This cavity is shown in Fig. 5

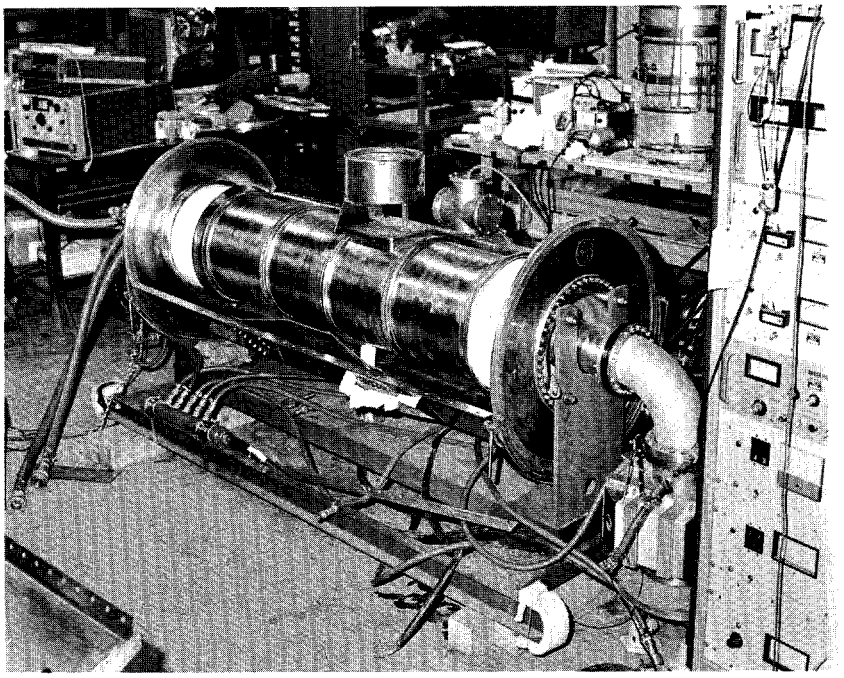


Fig. 5. A prototype main-ring rf cavity. The power amplifier, which is normally mounted on top, has been removed.

Experimental Facilities

1. Meson Laboratory. Phase I of the Meson Lab (formerly known as Area 2) is now out for bids. Completion is scheduled for July 1, 1971. Final design of Phase II is in progress--this second phase includes enclosures, service buildings, and utilities for secondary-beam lines, and the earth muon shield. Phase III will include the detector building.

2. Neutrino Laboratories. The design of this facility (formerly called Area 1) has been reviewed and modified. The length of the neutrino filter has been fixed at 1,000 meters of earth shielding. The length of the decay tunnel has been fixed at 400 meters. These lengths determine the position of the 15-foot bubble chamber near the intersection of Wilson and McChesney Roads and Road A, which is now being extended.

3. Superconducting Program. A 10-foot 20-kilogauss prototype dipole magnet has been operated for 285 hours non-stop. The maximum charging rate achieved was 10 kilogauss in 7 seconds, but this was limited by the power supply, not by the magnet. The steady-state heat load at 2 kilogauss is approximately 4 liters of helium per hour. Winding of a 10-foot 35-kilogauss dipole magnet is almost complete.

4. Meetings. Several meetings arising from the proposals for experiments will be held in the near future. The meetings will consider double-arm spectrometers, muon scattering, counter neutrino experiments, single-arm spectrometers, and multiparticle spectrometers. Proponents of the experiments have been invited to attend.

A list of presently approved experiments is given in the appendix.

Construction

1. Main Accelerator. Phase I, the first one sixth of the tunnel, is 96% complete and almost completely concerned with finishing work. Phase II, the remaining part of the tunnel, is 60% complete. Tunnel sections are being placed in Superperiod E. The RF Building in Straight-Section F has been completed structurally below ground and structural work is in progress on the above-ground building. The RF Building work is shown in Fig. 6.

2. Electrical Substation. This contract is 90% complete. It can be seen in Fig. 7. After some delays caused by late deliveries of guy-wire equipment, erection of the main power line has begun. The first pole (specially designed for NAL) is shown in Fig. 8.

3. Proton Beam Line. The proton beam line is 15% complete. Structural work is in progress, as can be seen in Fig. 7.

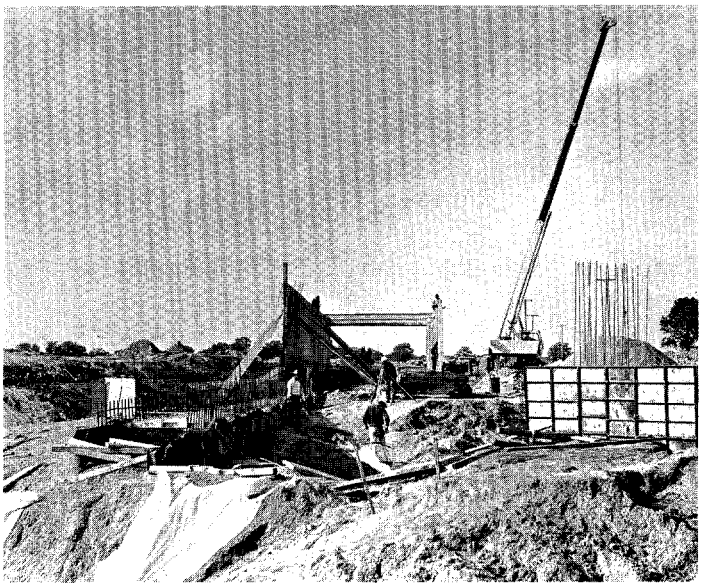


Fig. 6. Construction of the above-ground part of the RF Building in Super-period F.

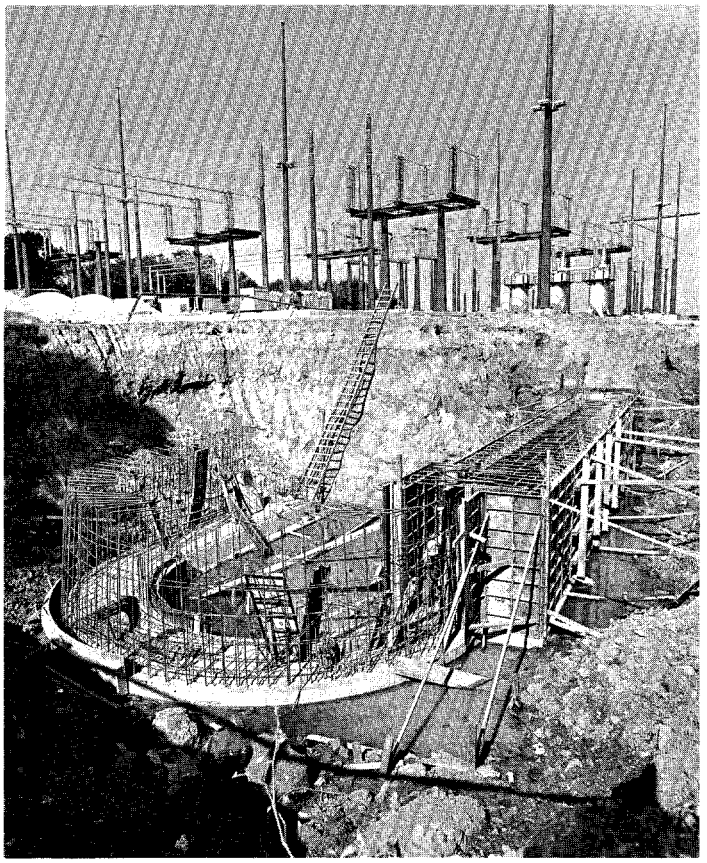


Fig. 7. Construction of an access tunnel in the proton beam line. The Electrical Substation is above and behind.

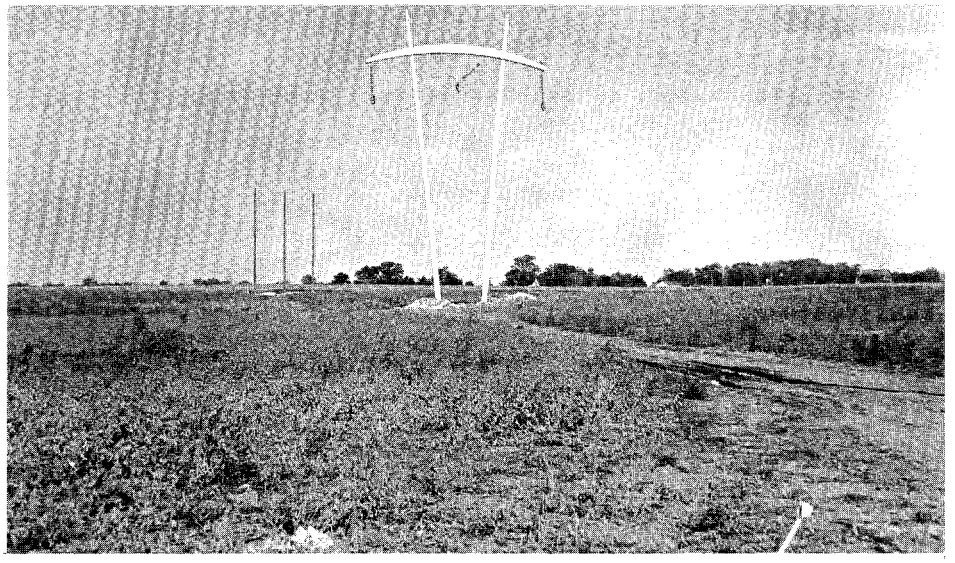


Fig. 8. The first power pole of the 345-kV line from the northeast corner of the site to the Electrical Substation.

5. Central Laboratory. Work has begun on Phase I of the Central Laboratory. Figure 9 shows this work.

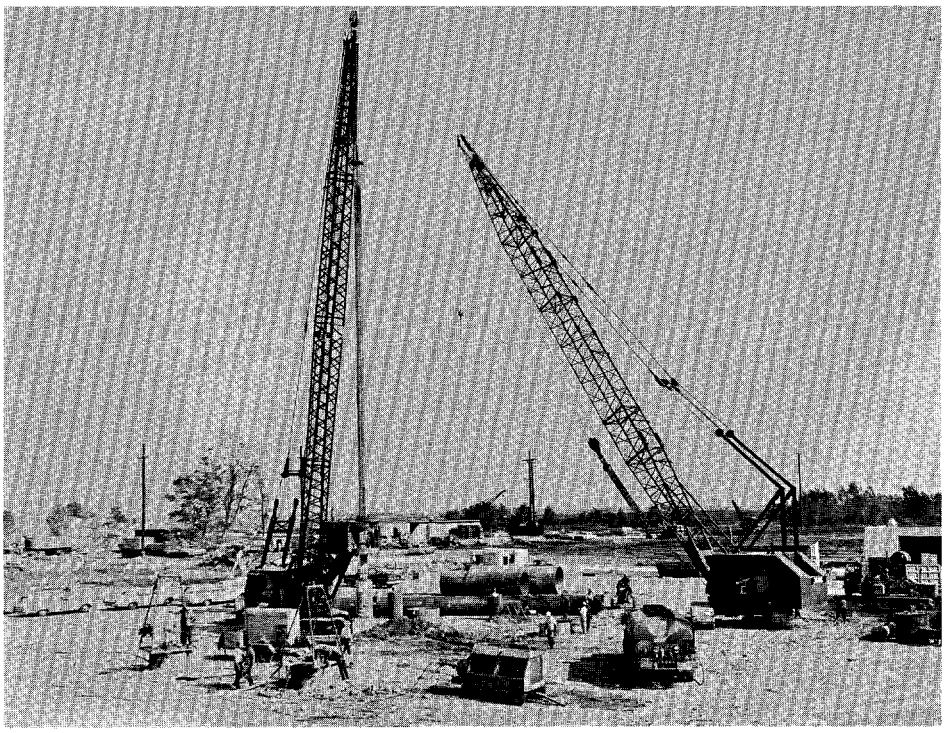


Fig. 9. Caissons being drilled for the Central Laboratory. This photograph was taken from the Linac Building.

Figures 10 and 11 are recent aerial photographs of the main construction and of the Laboratory Village.

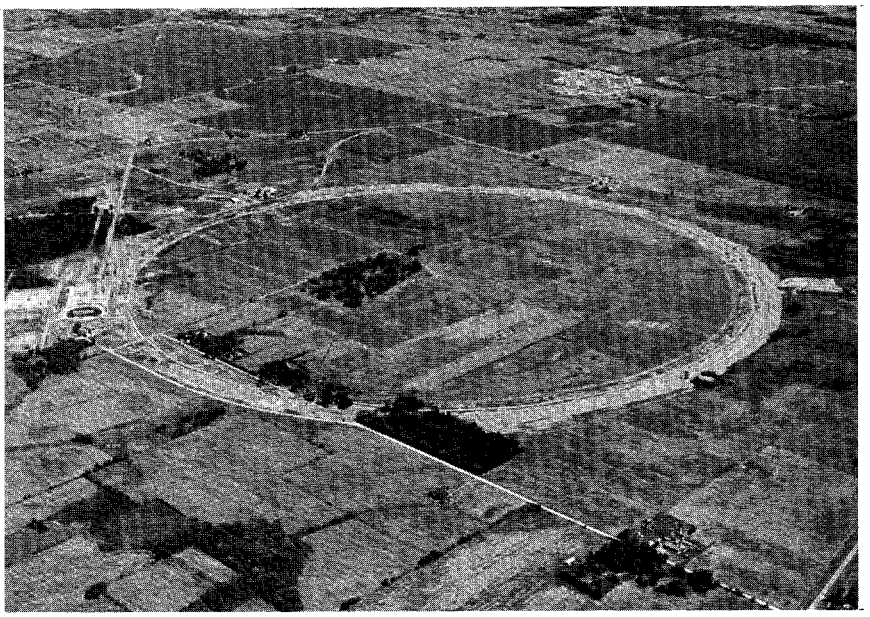


Fig. 10. An aerial view of the Main Ring, looking northeast. The injection area is at the left. The Village is at the upper right. West Chicago is at the top. Construction work on the "Village Expressway" can also be seen. This road will link the Village and the main site when Batavia Road is cut by construction of the Meson and Neutrino Laboratories. The power poles of Fig. 8 can be seen dimly to the north.

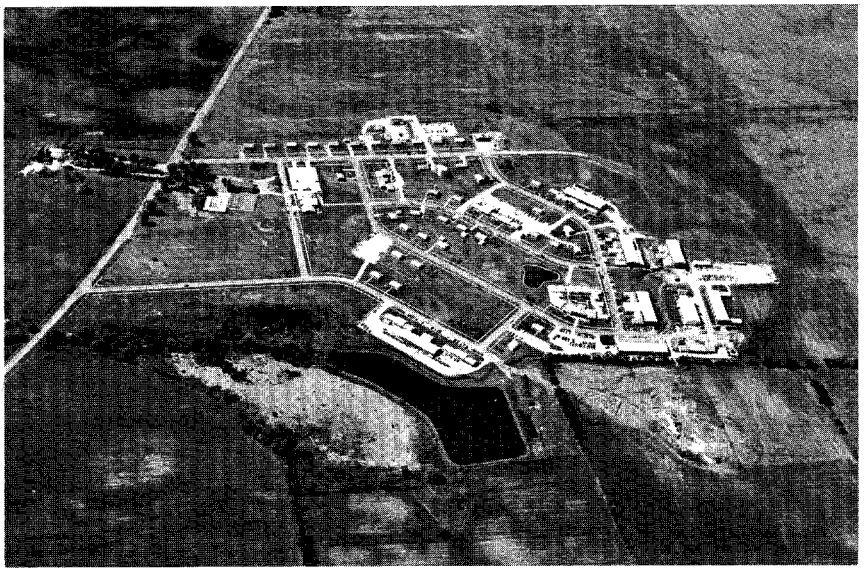


Fig. 11. A recent aerial view of the Village from the east. This view shows the results of our extensive house moving. The entire center area has been cleared and the houses clustered to help communication.

Laboratory Staff

On September 30, the Laboratory had 778 employees, including 155 scientists and engineers. This total includes 54 temporary employees in the magnet-manufacturing facilities, so that there has been very little growth in permanent staff in the last several months.

APPENDIX I. SUMMARY OF APPROVED PROPOSALS

Listed in the following table are those proposals that have been approved, as of now, for running at an early time after the appropriate experimental areas and secondary beams are in operation.

Also listed are non-approved proposals relating to a general area of physics which has been approved for running. In those cases, the particular group and technique have not yet been selected. Therefore, multiple proposal numbers are listed in parentheses. In all cases the institutions are given.

In addition to these approvals a number of requests for emulsion exposures have been received. These will be run whenever possible, on an informal basis, insofar as they do not seriously interfere with the normal development and operation of the accelerator.

SUMMARY OF APPROVED PROPOSALS

Proposal Numbers	Institution	Title of Proposal or Field of Experimentation
(1-A) (21) (38)	Wisconsin, Pennsylvania, Harvard Caltech, NAL ANL, MIT, NAL, Northwestern, Pittsburgh	Study of Neutrino Interaction Using Electronic Techniques
3 74 76	LRL, SLAC GE Research and Development, NAL NAL	Searches for Magnetic Monopoles
4	University of Michigan, ANL	Neutron-Proton Diffraction Scattering and Neutron Total Cross Sections Up to 200 GeV
12	Ohio State, Michigan State, Carleton	A Study of Neutron-Proton Charge-Exchange Scattering In the Momentum Range 50-200 GeV/c
7	University of Michigan, ANL, NAL	A Proposal to Measure $\pi^{\pm}$p and p-p Differential Elastic Scattering Cross Sections from 50 to 170 GeV/c
61	ANL, Harvard, LRL, Northeastern, Wyoming, Yale, NAL	A Proposal to Measure Polarization in pp, π^{-}p, and π^{+}p Elastic Scattering at 50, 100, and 150 GeV/c at NAL
8	Wisconsin, University of Michigan	Experiments in a Neutral Hyperon Beam
10 & 56	NAL, Rockefeller University, BNL	A Proposal to Measure the Total Cross Sections for $\pi^{\pm}$, $K^{\pm}$, P, and $\bar{P}$ on Hydrogen and Deuterium
13	NASA, Arizona, Louisiana State, Max-Planck Institute for Extra-Terrestrial Physics	Ionization Spectrometer Development and Calibration
22	Virginia Polytechnic, BNL	Experimental Proposal to the NAL for a Search for Multigamma Events

(SUMMARY-Cont.)

Proposal Numbers	Institution	Title of Proposal or Field of Experimentation
26	Cornell, Michigan State	High Momentum Transfer Inelastic Muon Scattering and Test of Scale Invariance at NAL
(5)	SLAC	Muon Scattering Experiments
(29)	Harvard	
(33)	Oxford, Chicago, NAL	
32	Stanford University	Test and Calibrate a Large NaI(Tl) Tanc Detector
34	Louisiana State, Max-Planck Institute for Extra-Terrestrial Physics	Ionization Spectrometer Development
(55)	Caltech	Study of $\pi^- p \rightarrow \begin{Bmatrix} \eta n \\ \pi^o n \end{Bmatrix}$
(84)	Case Western Reserve	
69	NAL, Yale	Elastic Scattering of the Hadrons
72	Yale, BNL	Experimental Proposal to NAL Quark Search
75	NAL	A Proposal to Search for Fractionally Charged Quarks
81	ANL, BNL, Chicago, Prudue, Carnegie-Mellon, SUNY-Buffalo	Preliminary Survey of 200 GeV Proton Interactions with Complex Nuclei
82	Chicago, SLAC, UCSD	Proposal to Investigate Regeneration of Neutral K-Mesons at Very High Energies